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Price and Income Elasticities of Iranian Exports

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Abstract: This study investigates the export demand elasticities at the aggregate and disaggregated levels over the period 1977 to 2001 for Iran. By utilizing an export demand model and using time series techniques that account for the nonstationarity in the data, the price and income elasticities of demand are estimated by commodity class. As the elasticities of demand for various categories of exports are different, while they are crucial for policy determination. Based upon the estimated results, price and income elasticities are almost similar to those obtained in earlier studies in the case of developing countries. The main findings of this paper demonstrate that, price elasticities are smaller than -1 for all exports categories, whereas the income elasticities are found to be greater than one. The results also suggested, the income elasticities of industrial goods are higher compared to other export categories, while the lower elasticities are found in primary exports. The price and income elasticity estimates have also good statistical properties.

Key words: Demand elasticities, exports, income and price elasticities, Iran

INTRODUCTION

Export is generally considered to play an important role in the economic growth of a country. Once a country establishes a certain share of the world market for a particular product, export performance is then highly dependent on external demand factors (as well as supply factors) and export led-growth is exclusively determined by the growth rate of imports in the rest of the world. Accordingly, export growth is closely related to the worldwide growth rate, (which is, by definition, exogenous for a small open economy (Osang and Pereira, 1997).

In this regard, the size of the price and income elasticities of LDCs' is a central element in export demand argument (Senhadji and Montenegro, 1999). The estimation of income and price elasticities for exports has been a traditional area of research in international economics. Aside from general academic interest, there has been a significant amount of emphasis placed on this topic. Because, they can be applied to many relevant macro-economic policy issues, e.g., the effect of both monetary and fiscal policies and expenditure switching policies, (such as exchange rate, subsidy and tariff policies), on a country's balance of payments, the impact of external balance restrictions on domestic policy measures, the international transmission of changes in economic activity and prices and the employment effects of changes in own or partner countries trade restraints (Algieri, 2004). The higher the income elasticity of the export demand e.g., in particular product, the greater will exports role be in growth (Goldstein and Khan, 1982). The higher the price elasticity, the more competitive is world market for exports of the particular country.

This issue has received an extensive empirical research during the last 30 years. More recent, are including Goldstein and Khan (1985), Bond (1987), Bahmani-Oskooee (1986), Marquez (1990), Reinhart (1995), Riedel (1995), Johnston and Chinn (1996), Giorgianni and Milesi-Ferretti (1997), Senhadji and Montenegro (1999), Peter *et al.* (2000) and Marquez (2002 and 2005) who did empirical studies for a number of developed and developing countries and present updated estimates. In general, the empirical results, found that the price and income elasticities play a significant role in the determination of trade flows. However, the vast majority of these researches have been directed toward relatively advanced economies (Sawyer *et al.*, 1997). Although a small number of studies are allocated towards developing nations such as Şahinbeyoğlu and Ulaşan (1999) and Erdogan Cosar (2002) who for instance estimated exports supply and demand functions for Turkey. Given the significant moves toward increased trade liberalization in recent years, this topic is of particular relevance in developing countries including Iran.

In other words, while the Iranian export performance has been the subject of a number of studies in recent years, (most of which concentrated on the relationship between exports growth and economic growth, (Atrkar Roshan, 2006; Motevasseli, 2000), this topic has not received sufficient attentions especially at the disaggregated level in recent years in Iran.

Because income and price elasticities vary across commodity groups and the exchange rate volatility can reasonably be presumed to affects sectors differently. Goldstein and Khan (1985) argued that disaggregation is preferred, as the estimates obtained directly from the aggregate relationship are likely to be biased. For the reason that, in aggregate trade equations, goods with relatively low price elasticities can display the largest variation in prices and exert a dominant effect on the estimated aggregate price elasticity, biasing the estimate downwards. A major advantage of using the disaggregated data according to Panagariya *et al* (1996), is that unit-value indices that must inevitably be used to represent prices are far more meaningful in these data than in aggregated data. While the estimation of disaggregated data might reveal some relationships that cannot be observed in aggregate level. Investigation of exports performance on e.g., sectoral basis is essential to monitor the structure of the exports. Furthermore, compositional changes are far less likely to pollute unit values when data are highly aggregated (Riedal, 1995; Funke and Ruhwedel, 2001).

Accordingly, the price and income elasticities of demand are estimated by utilizing an export demand model for Iran. The purpose of this study is to investigate empirically, the issue of aggregate as well as disaggregated export flows. While many of the relevant literatures estimate demand functions using highly aggregated data, the analysis here is conducted at both aggregate and disaggregated level. Accordingly, further insight into Iranian export development is obtained through disaggregating them by commodity class, including total exports, exports of mineral fuel, primary commodities, carpets and exports of manufactured goods.

THE MODEL AND DATA

Following the generally accepted specification in Goldstein and Khan (1985), the underlying model is based on the standard laws of demand. However, the choice of which specific variables to use is fairly wide. The model dominated the empirical literature for more than a quarter century, because of the empirical success of this specification and the data limitations prevailing in LDCs, (Senhadji and Montenegro, 1999). The main assumption of the model according to Goldstein and Khan (1985) which discusses in detail the problems of modeling trade, is that, in a simple two-country world, each country produces a single tradable good that is an imperfect substitute for the good produced by the other nations. The country's exports will face competition not only from domestic producers in the importing region, but also from other exporters to that region. Thus, normally it is assumed that the dominant relative price competition occurs among exporters.

In view of the non-fuel exports growth especially during the 1990s in Iran (which, partly resulted from exchange rate policies), it is our purpose to assess the effect of exchange rate on trade flows too. Since exchange rate volatility can reasonably be presumed to affect sectors differently, following Bahmani-Oskooee (1986) and others, an exchange rate variable is added in log-linear form. Obviously, by applying a log-linear form of the regression, reliable results for export demand of the Iranian economy are obtained. Thus, following Bahmani-Oskooee (1986) the model is specified in log-linear terms as:

$$\log (X_{it}) = a + b \log \left(\frac{PI_i}{PW_i}\right)_t + c \log (IW_{it}) + d \log (E_{it}) + u_{it} \quad (1)$$

where:

- Xi = Exports volume (in thousand metric ton),
- I = Total exports, exports of mineral fuel, exports of non fuel, exports of primary commodities, exports of manufactured commodities and also exports of carpets.
- Pi_{it} = Unit value of Iranian total exports,
- PW_{it} = Unit value of competitors exports,
- IW_{it} = Weighted average of index of world real income,
- W_{it} = Real effective exchange rate.

Economic theory provides insight into how each variable in Eq. 1 should affect exports performance. It is expected that b will be negative and c positive. The expected sign of the E parameter is negative, as the higher the real effective exchange rate ceteris paribus, the smaller would be the demand for the country's exports. In summary it is expected that $b<0$, $c>0$ and $d<0$.

Since the exports of carpets was traditionally important, accounting for about one third of Iran's non-oil exports for up until the end of 1980s, in this study it has been analyzed as a separate category, with the model being applied to that sector as well as to other commodity groups. Therefore, on the basis of Eq. 1, the disaggregated commodity groups including total exports, fuel exports, primary, industrial and carpet exports are estimated, respectively that is named as Eq. 1-5 correspondingly.

The period under consideration of this study contains a range of different episodes for Iran. These are including a sharp collapse of oil price in 1986-1988, the Islamic revolution in 1979, the commencement of the war in 1980 and the trade embargos. In order to capture the

data break and examine the effects of these sudden changes on dependent variables, three dummy variables are constructed and introduced in the model, which takes the value of 1 for the specified period and zero otherwise.

All data from 1977 to 2001, are annual and in constant 1990 prices. In order to include all relevant trading partners it has been concentrated on the effective exchange rate, as given in the IMF (2001) (International Financial Statistics) database. The inclusion of trading partner economic growth is calculated as the trade weighted rate of economic growth of Iran's major trading partners in any given year (over a period of 15 years). The figures on trading partners' income at constant 1990 prices are also obtained from International Financial Statistics. Data on world income is calculated using the method described by Bahmani-Oskooee (1986). Statistics on the volume and unit value of exports are obtained from Iran's CBI (Central Bank of Iran, 2000) and Custom Administration of Iran, while data on the unit value of competitors come from the (UN), International Trade Statistics Yearbook, volume II, (the complete list and source of data series is not reported in this study, but is available on request from author). The estimation of the models is carried out by OLS (ordinary least square) technique using the Views econometric package.

UNIT ROOT TESTS, COINTEGRATION AND CORRELATION MATRICES

A problem that has been largely ignored in many relevant literatures is that of probable nonstationarity of the data, which invalidates classical statistical inference. If the variables that enter the export demand equation are found to contain a unit root, ignoring nonstationarity in these variables may lead to incorrect inferences. Failure to consider the nonstationary of these variables could in part lead to the inclusion of modeling variables and errors in determining the effects of the exchange rate, income and relative prices (In and Sgro, 1998). Hence, the properties of the time series are established prior to testing the model. It is necessary to assess if the implied theoretical model is capable of describing the data and what we set out to do is to ensure that inference regarding income, relative prices and exchange rate are not clouded by a spurious element.

The findings imply that the unit root hypothesis cannot be rejected at conventional significance levels. The ADF test confirms that the variables are integrated of order one i.e., I (1) in level, but integrated of order zero i.e., stationary in first differences (Table 1). Thus, the next step is to test for cointegration based on Engle and Granger (1987). This tells us whether the long-run behavior of export demand is adequately specified. Accordingly, the residual-based Augmented Dicky-Fuller

Table 1: Unit root tests (Augmented Dickey-Fuller, ADF test)

	ADF test			
Variables	Test statistics (level form)	Order of integration	Test statistics (first difference)	Order of integration
Lxt	-2.05	I(1)	-7.21*	*I*(0)
Liwt	-2.40	I(1)	-4.00**	*I*(0)
Le	-1.07	I(1)	-3.34***	*I*(0)
Lt	-1.06	I(1)	-4.70*	*I*(0)
lf	-3.13	I(1)	-4.44*	*I*(0)
LXf	-1.34	I(1)	-5.01*	*I*(0)
LMAN	-1.62	I(1)	-4.75*	*I*(0)
Liwn	-2.20	I(1)	-3.76**	*I*(0)
LXMA	-3.11	I(1)	-7.49*	*I*(0)
LXP	-2.36	I(1)	-5.49*	*I*(0)
LP	-2.58	I(1)	-5.00*	*I*(0)
LXK	-3.01	I(1)	-3.57***	*I*(0)
LK	-2.38	I(1)	-3.54***	*I*(0)

Critical values are based on Mackinnon (1991). * Significant at 1% level.** Significant at 5% level. *** Significant at 10% level

Table 2: Cointegration tests (Residual-based ADF tests; aggregate and Disaggregated data)

	ADF test		
Equation No.+	Test statistics	R2	D-W
1	-6.34*	0.65	2.14
2	-6.40*	0.65	2.25
3	-5.63*	0.68	1.83
4	-5.36**	0.64	1.85
5	-5.81*	0.74	1.51

Note; Critical values are based on Engle and Yoo (1987). Sufficient lags were included to eliminate serial correlation, *Significant at 1% level.** Significant at 5% level, + (1) total exports, (2) fuel exports, (3) primary, (4) industrial and (5) carpet exports

test is employed to determine the possible cointegration between the variables. Following Serletis (1992), the simulated critical values reported in Engle and Yoo (1987) (Table 2) is used, which also takes into account the number of variables for the Z (t_α) statistic at a 1, 5 and 10% significance level. Table 2 of this study reports the residual-based ADF test results for cointegration, which appear to support stationarily of residuals, i.e., cointegration exists among the variables involved.

Furthermore, the possible nature of correlation between the variables is also investigated. This provides some insight into identifying possible collinearity between the independent variables, by presenting the correlation matrices of the models. The results indicate that, the high degree of correlation do not exist among the relevant variables of the models (correlation matrices test results are not reported in this study, but are available on request from author).

ESTIMATION RESULTS AND ANALYSIS

All variables in the estimated equations have the theoretically expected signs and diagnostic tests, which are reported in Table 3, support the statistical appropriateness of the equations. The outcome of these

Table 3: Estimated aggregate and disaggregated Iranian export demand equations

	Dependent variables									
	LXT		LXF		LXP		LXK		LXM	
	Equation No.									
Independent variables	(1)	(2)+	(3)	(3)+	(4)	(4)+	(5)	(5)+	(6)	(6)+
C	-0.78	0.72	0.12	0.15	-0.15	0.46	-2.75	-2.43	-11.9	-12.2
	(0.29)	(0.28)	(0.06)	(0.08)	(-0.02)	(0.06)	(-0.90)	(-0.83)	(-1.77)***	(-1.83)***
Relative price	-0.34	-0.34	-0.22	-0.21	-0.02	-0.00	-0.57	-0.54	-0.83	-0.83
	(-2.22)**	(-2.24)**	(-1.68)	(-1.68)	(-0.11)	(-0.02)	(-1.89)***	(-1.87)***	(-2.52)*	(-2.59)*
Income	1.28	1.23	1.02	1.01	2.61	2.58	2.42	2.40	4.86	4.87
	(2.62)*	(2.57)*	(2.94)*	(3.01)*	(1.77)***	(1.77)***	(5.33)*	(5.41)*	(3.89)*	(3.84)*
Exchange rate (LE)	-0.06	-0.02	-0.01	-0.01	-1.21	-1.32	-0.72	-0.77	-1.15	-1.15
	(-0.42)	(-0.20)	(-0.12)	(-0.11)	(-2.61)*	(-3.01)*	(-2.15)**	(-2.42)**	(-2.08)**	(-2.07)**
D1	-0.39	-0.40	-0.23	-0.24	0.46	0.49	0.35	0.38	0.44	0.50
	(-4.57)*	(-4.89)*	(-2.34)**	(-2.53)*	(1.10)	(1.22)	(1.11)	(1.24)	(1.36)	(1.63)***
D2	-0.07	-	-0.02	-	-0.28	-	0.20	-	-0.28	-
	(-0.78)	-	(-0.27)		(-0.78)		(0.53)		(-0.93)	
D3	-0.25	-0.26	-0.30	-0.31	-1.70	-1.81	-0.91	-0.82	-0.34	-
	(-2.43)**	(-2.63)*	(-.3.15)*	(-3.31)*	(-3.41)*	(-3.85)*	(-2.70)*	(-2.90)*	(-0.85)	
R2	0.77	0.78	0.73	0.75	0.61	0.62	0.75	0.76	0.88	0.88
D-W	2.07	2.00	2.00	2.03	1.85	1.71	1.74	1.78	1.93	1.63
No. of observations	24	24	24	24	25	25	25	25	24	24
Normality test[c]		0.22		0.20		0.81		2.50		1.38
ARCH Lm test[d]	χ^2 (1) = 1.33		χ^2 (1) = 0.44		χ^2 (1) = 1.85		χ^2 (1) = 0.76		χ^2 (1) = 0.00	
Ramsey Reset test[e]	F (1,24) = 2.19		F (1,24) = 0.92		F (1,25) = 0.74		F (1,25) = 0.11		F (1,24) = 1.48	

Note: figures in parenthesis are t statistics. DW is the test statistic for the first order autocorrelation in the error term.*Significant at 1% level.** Significant at 5% level.*** Significant at 10% level, + Indicates that the equation is a re-estimate of the preceding one, with non-significant variables dropped, c) Jarque-Bera (normality) is a test statistic for investigation of whether the series is normally distributed., d) Lagrange multiplier test for residual serial correlation. e) Ramsey RESET test is a regression specification error test, LXT is defend as the volume of total exports, LXF is the volume of oil exports, LXP, is the volume of primary exports, LXK, is the volume of carpet exports, LXM is the volume of manufactured exports

tests indicates that the equations perform well, exhibiting no problems of functional form misspecification (Ramsey's Reset test) and heteroscedasticity (LM test). The results also demonstrate that, normality was achieved in all cases.

The findings of the presence of the significant dummy variable D1 clearly indicate that the fall of the oil price and then the sharp reduction in exchange earnings adversely affected oil exports and total export demand as a consequence, as Iranian export earnings were on average 80- 85% dependent to oil exports over the period, while the impact was positive and mostly significant for some other equations (e.g., for manufactured exports). This expected reverse effect occurred partly due to existence of a reversed relationship between exports of fuel and non-fuels in Iran. While the dummy variable D2 reveals that trade sanction did not produce significant impact on the export demand, the dummy variable D3 is negative for all estimated equations.

All price coefficients and exchange rate variables are negative as expected, which implies that the relative price negatively affects export demand. The price elasticity in this study for total exports (-0.34) is close to that was given by Reinhart (1995). The results are also consistent with most other empirical studies (ealier), such as Reinhart (1995), (her mean estimate over the ten LDCs showing the right sign is -0.44), while the mean is -1.14 (for over 37 developing countries) in Senhadjis' sample. The interpretation of these results and the differences can be mainly because of the dissimilarity in the period of analysis and sample sizes. The findings also strongly indicate that trading partners' income positively affects Iranian export demand given that income elasticities in all exports categories are larger than one. Since income elasticities are larger than one and as the higher the income elasticity of the export demand, the powerful will exports be as an engine of growth. It can then be concluded that; based on the magnitude of the Iranian exports, growth in the partner's countries will translate into growth in Iran. (The trade linkage between growth in industrial countries and growth in LDCs is analyzed in detail in Goldstein and Khan 1982 and Senhadji and Montenegro, 1999).

However, the price coefficient for oil exports (in regression 2) is not significant in this study, due to a variety of possible explanations. Firstly, the quantity demanded of mineral fuels is little affected by relative oil prices, since OPEC sets homogenous prices in world markets and secondly, because OPEC largely determines exports of crude petroleum. Iran, as a member of this organization, obeys its quota allocation, so that the quantity demanded is not determined by price. Third, the

energy conservation policies of industrialized countries, after the first oil price shock of 1973, led to a significantly lower role for price, in determining the demand for mineral fuel (mainly crude petroleum) in regression (2).

However, the sign of exchange rate coefficients are negative and statistically significant for all other equations, except for fuel exports and total exports as a result. This indicates that, export demand, especially industrial exports respond perfectly to the changes in exchange rate and it can be accounted as an important factor in Iran's expansion of exports, as it was evident in other LDCs. Similarly, while relative prices have a predictable and systematic impact on export demand, price elasticities tend to be higher for some category of exports such as manufacturing exports. The price and income elasticities for industrial exports (in regressions 5) are statistically significant at the one percent level.

Overall, the findings demonstrate that, the income elasticities of industrial goods are higher compared to other export categories, while the lower elasticities are found in primary exports (and also carpet exports). The results also point to a price elasticity smaller than -1 for all export categories, while manufactures exhibit higher price responsiveness than primary goods and carpet exports as expected. Such results demonstrate that industrial goods are more sensitive to changes in price and income. Thus, the responsiveness of relative price and income for industrial exports suggests that a country like Iran, which is concerned with increasing export revenues, should pay sufficient attention to these factors in targeted markets, whilst it also indicates the important role of this export category in increasing demand and revenues as a result.

CONCLUSIONS

The purpose of this study was to estimate the income and price elasticities of demand for Iranian exports. The results point to a price elasticity smaller than -1 for all export categories, the sign of exchange rate coefficients are negative and statistically significant, while income elasticities in all export categories are larger than one. The findings also demonstrate that, the income elasticities of industrial goods are higher compared to other export categories and exhibit higher price responsiveness while the lower elasticities are found in primary exports.

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